GUARANTEED LONG-TERM SAVINGS PERSISTENCE AN OWNER'S PERSPECTIVE

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ABSTRACT

In 2003, all Texas State Agencies experienced a 12% budget cut creating difficulties for agencies across the board that are obligated to provide basic services to the clients they serve. Since cutting services to clients is not an option, the Texas Mental Health and Mental Retardation agency, now consolidated into the Texas Health and Human Services Commission (HHSC), was challenged to deal with this issue by maintaining its aging infrastructure. Funding for repairs and replacements was reduced from $72 million to $35 million with documented deferred repairs and replacements amounting to more than $250 million. The agency was compelled to search for alternative methods to fund its large obligations and decided to capitalize on new Texas legislation that was passed in 2001.

This paper describes how the agency utilized Energy Savings Performance Contracting (ESPC) to upgrade its HVAC infrastructure since the state legislation protected existing utility budgets for such cost-effective projects that could be financed and repaid within fifteen years. To accurately account for the guaranteed savings, it is imperative to apply detailed as well as practical Measurement and Verification (M&V) techniques. The agency worked closely with a competitively chosen energy services company (ESCO) to generate a cost effective M&V approach that has a savings persistence program that both parties effectively put into practice; thus ensuring long-term goals will be met.

INTRODUCTION

During the 2001 77th Texas Legislative Session, legislation was passed and signed by the Governor of the State of Texas, directing State Agencies to implement cost effective energy and water efficiency measures. In order to comply with the legislation and meet immediate repair and replacement needs, segments of the Texas Health and Human Services Commission (HHSC), formerly the Texas Mental Health and Mental Retardation (MHMR) agency, took steps to enter into an ESPC. In November of 2002, the agency issued a Letter of Interest to receive responses from potential performance contracting vendors. Vendors that qualified for the short list of requirements were asked to submit a rigorous Response for Qualifications. After a thorough review of each company, the agency selected an ESCO to investigate all possible utility savings opportunities and implement the recommendations at 23 agency campuses located across Texas.

The first step the ESCO took was to perform a preliminary utility audit survey of 23 campuses comprised of 10 mental health facilities and 13 mental retardation facilities with approximately 1,400 buildings throughout the state. These facilities consist of 24-hour per day, 7-day per week full-service to clients with mental illness and mental retardation conditions. After visiting each site and performing basic analysis of utility savings opportunities, the ESCO divided the sites by region into five initial phases so that a more detailed utility audit of each facility could take place. The results of the preliminary utility audit anticipated that ESPC has a potential to implement approximately $52.3 million in energy and water related facility improvements including over $31.4 million in repair and replacement needs that are paid from savings. Once fully implemented, the project should achieve savings of over $4 million per year, or approximately 20% of the current utility budget. The ESCO will guarantee the savings for fifteen years in order for the agency to repay the loan.

After an overall agreement was reached, the ESCO and the agency signed a detailed utility audit contract for Phase One that included five sites whereby the ESCO was charged with finding the maximum possible savings opportunities that could be paid for and financed within a fifteen-year term. The agency actively involved itself in all portions of the project development functions by providing input in all relevant decision making stages. Agency involvement was vital in achieving the goal of providing the state taxpayers and agency clients with the most value possible. By approaching the project as a team rather than a traditional customer/vendor relationship, more overall value can be achieved in a shorter time span, especially when both parties have demonstrated a willingness to cooperate together as much as possible.

During this utility audit stage, lengthy discussions took place to decide on the most practical methods that could be performed cost-effectively. Both the agency and the ESCO had to overcome the challenges associated with agreements that satisfied each of the respective party's best interests by working as a well-balanced team. These types of projects, if not implemented properly, have a history of producing poor results. Promised savings either never materialize to their full potential or tend to wane away over time. Therefore, the agency was determined to turn the process into a successful model that other state agencies may follow due to the high financial stakes involved while simultaneously minimizing risk to the agency. The Energy Systems Laboratory (ESL) of Texas A&M University, a State of Texas agency acting on behalf of the agency as the owner's representative, took part in the development of the Measurement and Verification (M&V) strategy in order to assure that the savings were derived from meaningful measurements. As the owner's representative, the ESL was also involved in reviewing savings calculations and construction/retrofit oversight.

EQUIPMENT RETROFITS

The detailed audits of each campus in Phase One identified a number of recommended utility savings opportunities including energy efficient lighting, more efficient chillers, energy management and control systems, window films, low flow faucets/showerheads, and low flow toilets. The majority of the campuses did not have any control systems,

thus installing them had the potential to provide large savings opportunities. Installing a control system will also help increase the comfort level of the agency's clients and employees as well as significantly reduce the number of hot and cold calls which number into the hundreds per year at most campuses. In most cases, the lighting quality also will be appreciably improved due to the lighting upgrade. This also helps those clients with vision impairments. In addition, it was determined that large savings opportunities exist by closing steam plants and loops and installing dedicated water heaters in individual buildings served by the utility loop. This opportunity is particularly important to the agency because of a long-term desire to eliminate steam loops due to the considerable amount of maintenance requirements, workplace hazards, and energy consumption resulting from steam losses of antiquated systems. A typical steam loop was estimated to be less than 50% efficient in delivering steam to the point of use.

The main ESPC project consists of five phases that will include traditional ESPC opportunities similar to the ones described for Phase One. Phase One at five campuses will cost $13.9 million and will provide the agency with approximately $1.47 million in annual savings once completely implemented. Phase Two, currently under implementation, has work being performed at five additional sites at a total cost of $11.5 million and will generate $1.24 million in annual savings. Phase Three is currently in the detailed audit stage at five more sites and will be followed by Phases Four and Five. An additional phase, Phase Six, was added shortly after Phase One and includes consolidating laundry facilities into centralized sites by utilizing more efficient large Continuous Batch Washers (CBW) instead of many low efficiency washers. The ESCO performed a preliminary study and determined that this project could pay for itself as a stand-alone phase through electric, natural gas, and water savings. The CBWs are automated washers that recycle significant amounts of water, thus saving water and energy to heat the water. This phase is being implemented concurrently with Phase One. The cost of this phase is $5.2 million and will save approximately $580,000 annually.

The project financing comes from two sources, the Texas Public Finance Authority (TPFA) and the Texas LoanSTAR Program. The agency will use TPFA's Master Lease Purchase Program, which offers a variable interest rate of 3-5% and is financed over fifteen years. The second funding source is provided through the Texas State Energy Conservation Office's (SECO) LoanSTAR program with a 3% interest rate. This is a revolving loan fund for public sector energy efficiency projects in Texas.

DETAILED MEASUREMENT AND VERIFICATION

A critical aspect of performance contracting involves M&V strategies that correctly account for savings. Both parties have a vested interest. From the owner's perspective, one needs to ensure that sufficient utility savings funds are available to pay for the project's total debt service. The vendor's keen interest in M&V arises because the company does not wish to have any savings shortfalls and be required to make up for the difference. On-going M&V allows the ESCO to monitor the savings and detect when savings begin to degrade. The ESCO can then protect its interests by seeing the issue is quickly resolved. Two documents can be used as the basis of the M&V plan, the

International Performance Measurement and Verification Protocol, [1] and also ASHRAE Guideline 14-2002 [2]. The use of calibrated simulations with the M&V plan, such as those detailed by Haberl and Bou-Saada [3] is also planned.

Too often, both parties contribute to problems that can persist over the long-term if not addressed early on in the development process. One significant and costly error that many owners make is deciding to discontinue the M&V contract with the vendor after two or three years. Owners usually make this decision because they mistakenly believe that once the savings have been established and the first or second year savings guarantee is met, savings will consistently continue for the duration of the debt service term. This misguided belief has created unhappy customers when savings decline. In most cases, savings will fall off because old operator habits generally tend to return causing energy consumption to increase. A study on persistence by Claridge et al. [4] shows that savings decrease between 10% and 30% per year without effective M&V. If no M&V analysis exists to keep "savings loss creep" in check, the true scale of the problem can remain hidden from normal accounting methods. Additional M&V guidance can be found at the US Air Force web page [5] for specific retrofits. Information about ESPCs can also be found at this web site.

For Phase One, the annual M&V cost is $135,625, which amounts to approximately 9% of the projected annual savings. This service includes quarterly savings reports, an annual savings report, and regular site visits by ESCO personnel to continuously monitor site utility consumption and troubleshoot any problems to ensure that the savings are met. It also includes periodic training to keep site personnel up-to-date with operations and maintenance procedures and issues. Since savings have previously been shown to decrease between 10% and 30%, the annual M&V cost is a worthwhile effort. Therefore, the cost of savings persistence should be viewed as an investment in maintaining the savings rather than an expense and the cost should be fully borne by the project. It should also be noted that many energy services companies reserve the right to discontinue the savings guarantee if the owner cancels the M&V contract.

From a vendor perspective a good quality M&V program will pay dividends over the long-term. The primary reason a vendor should pursue a good M&V strategy is to avoid having to unnecessarily fulfill its guarantee with a check to the customer in order to compensate for a savings shortfall. Another excellent motivation is to stand out as a premier vendor in the industry with a competitive edge by building a reputation for quality work that is fair and equitable to both parties. Without effective M&V, customers can be left in an unfortunate financial situation when a vendor does not provide high quality work, a good method of accounting and the necessary follow up to sustain the savings. For large customers, having an in-house energy management team is imperative to manage large projects. If inside staff cannot be made available, a competent outside consultant should be considered. HHSC is successfully utilizing both avenues to manage this project.

By working together over a period that spanned approximately nine months, the agency and the ESCO developed an extensive plan to utilize Option C, before-after retrofit

savings of the International Measurement and Verification Protocol (IPMVP) on a whole building utility meter level. Since this vendor had extensive experience with a popular M&V accounting package [6], which contains a whole-building statistical modeling capability, this was determined to be an appropriate tool to use for the project M&V. The agency and the Energy Systems Laboratory performed several independent side-by-side comparisons of the software against ASHRAE's Inverse Model Toolkit (IMT) in order to be more comfortable with the long-term results. The weather data, containing daily high and low temperatures, was obtained from the National Weather Service nearest to the site to perform weather normalization analysis. Utility bill whole-meter electricity and natural gas consumption data were modeled versus the average of daily high and low temperature data to obtain weather-normalized models. After verification, the agency agreed to use the weather-normalized models as the baseline models. The ESCO was directed to use either two or three twelve month sets of data in order to obtain an improved model. When more than twelve months of data was not available, a one year dataset was deemed to be sufficient. Smaller meters such as parking lot lighting meters were not used in the analysis.

The Detailed Utility Audit and M&V Plan contains information that includes which IPMVP measurement method is used, the baseline models that were developed, the allowed adjustments and how they will be dealt with over time, and the determination of the utility cost saved. A full accounting of all the guaranteed meters was completed with detailed documentation of the utility rates and riders that are in place at the time of implementation so that the savings can readily be recalculated independently of the vendor. In addition to accounting for all the meters, each meter was audited for billing accuracy by recalculating the bill on a spreadsheet using the rate structure obtained from the utility company. This not only established whether the proper amount was charged, but also ensure that the baseline data is correct going forward. The ESCO submitted electronic files which included the weather data used during the baseline period and all simulation model input files for independent verification.

Because this is a long-term project which will be carried out over fifteen years, the agency was adamant about meticulously detailing every aspect of the project. All involved recognized that personnel on both sides of the project will ultimately change over time; thus the need for thorough documentation that can be easily comprehended by anyone who takes on the role of managing this project in the future. By working together, the agency and the ESCO developed documentation that is not normally included in Detailed Utility Audit Reports and M&V Plans.

An important part of detailed M&V includes basic metrics that can help identify possible problem areas by simply comparing relative magnitudes of similar retrofit recommendations. These relative magnitudes can be side-by-side percentage comparisons of site energy use for each site and energy efficiency measure, and savings for each. Another metric used in this project that can spot an abnormality is a utility percent reduction that shows how much of the overall utility meter is being proposed for savings. On various occasions, these tools proved invaluable in rooting out problems before the project was finalized and an implementation contract signed.

RESULTS

Construction of the first phase is nearing completion with preliminary results now being available. This was especially important to the agency because the first debt service repayment came due requiring proof that savings did indeed occur.

The agency worked with the ESCO to develop M&V quarterly and annual report formats that are usable for energy management purposes and also for accounting and senior administration purposes. Detailed savings reports that document each part of the savings create confidence in senior management that the savings are being obtained and to encourage further investment. In these reports, utility usage and costs for each site are shown compared to the baseline usage. They are summarized per site, month, quarter, and according to project phase.

Figure 1 shows a cumulative graph of the savings to-date. It breaks down the savings according to the different utility savings components for the first phase of this project that includes five sites. It also compares the savings to the annual guarantee level and divides the savings into its electric, natural gas and water components. The stipulated portion of the savings, which is approximately 2% of the total savings, is derived from eliminating the use of boiler chemicals at the steam plant and changing to a more favorable electric rate schedule at one of the five sites. In addition, Phase One contained a CBW project at one of the five sites that is separate from the CBW project in Phase Six. Figure 2 shows a more detailed view of the data in Figure 1 with seven months of accumulated savings data versus the guarantee.

Table 1 is a summary of the savings versus the baseline for each of the five sites in the first phase. It shows the measurement based savings for electricity consumption, electric demand, and natural gas savings. The Cost Savings portion of the table subtracts the Measured costs from the Baseline costs to obtain the savings. The difference is then compared to the Guarantee level. The Target kWh, Target kW, and Target CCF data is what the ESCO predicted during the detailed audit phase. This is intended to be used as a direct comparison to the “Measured” column. Since this project is still in the construction portion, the full savings have not been realized yet. The sites have not been fully commissioned yet and may therefore show negative savings in some of the months. Table 2 is similar to Table 1; however, it includes the Measured cost versus the Baseline cost for each month in the first quarter rather than by individual site.

CONCLUSION

Faced with large budget cuts and state mandates to reduce utility costs, HHSC took the initiative to pursue energy savings performance contracting as a vehicle to finance much needed large scale infrastructure projects due to having more than $250 million in deferred repair and replacement needs. Desperately needed higher efficiency equipment is being installed in accordance with state guidelines. The guidelines mandated that each capital improvement project must be examined for utility savings potential before

funding is requested and approved. The utility savings will pay for the projects over a fifteen-year term. The benefits will be realized by the state taxpayers, the clients served by the agency, the agency employees, and the environment as a whole through resource conservation and emissions reductions.

This paper demonstrated that detailed utility audit report and M&V documentation is essential in any project, whether large or small, particularly when it will have a long-term legacy. Because utility budget funding is secured by legislation for the duration of the project derived from the baseline year, proper M&V must occur to guarantee that there will be sufficient funds available to repay the debt service.

REFERENCES

[1] IPMVP. 2002. International Performance Measurement and Verification Protocol. *IPMVP*

[2] ASHRAE. 2002. Guideline 14-2002-Measurement of Energy and Demand Savings. *American Society of Heating, Refrigeration and Air-conditioning Engineers*

[3] Haberl, J.S., and Bou-Saada, T.E. 1998. Procedures for calibrating hourly simulation models to the measured building energy and environmental data. *Journal of Solar Energy Engineering* 120(8): 193-204.

[4] Claridge, D.E., Turner, W.D., Liu, M., Deng, S., Wei, G., Culp, C., Chen, H., and Cho, S.Y., "Is Commissioning Once Enough?" *Energy Engineering*, Vol. 101, No. 4, 2004, pp. 7-19.

[5] US Air Force (2005), "Facility Energy Management Program", http://www.afcesa.af.mil/ces/cesm/energy/cesm_energy.asp.

[6] Sonderegger, R., 1998. "A Baseline Model for Utility Bill Analysis Using Both Weather and Non-weather-related Variables," ASHRAE Transactions, TO-98-12-2: 18.

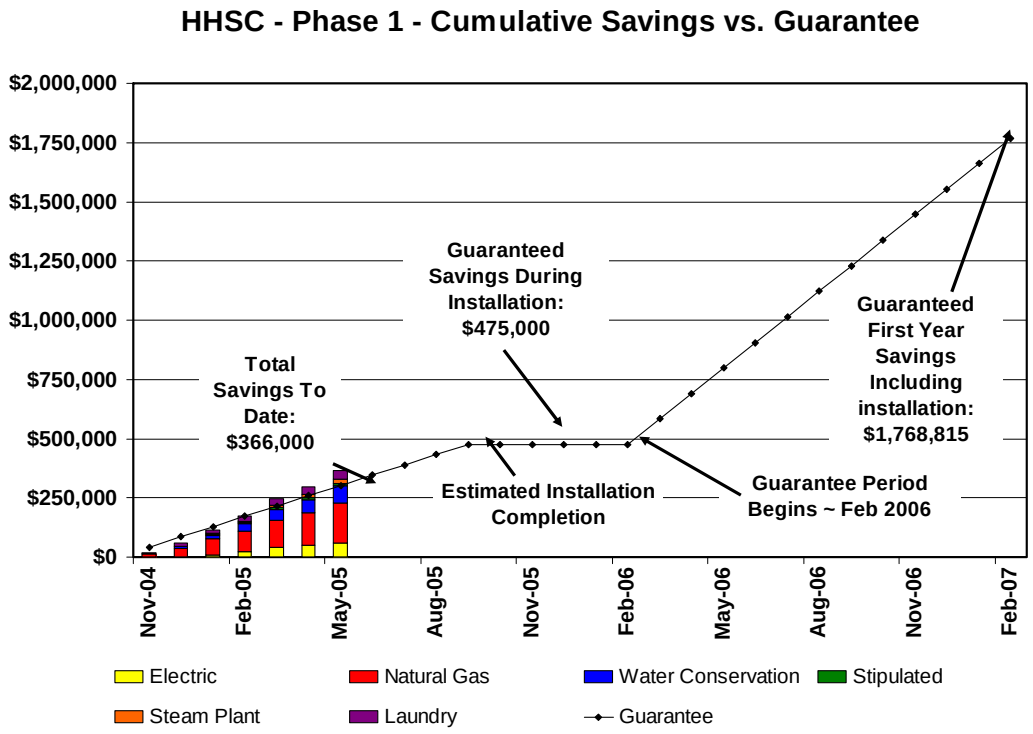

Figure 1. Phase One Cumulative Savings

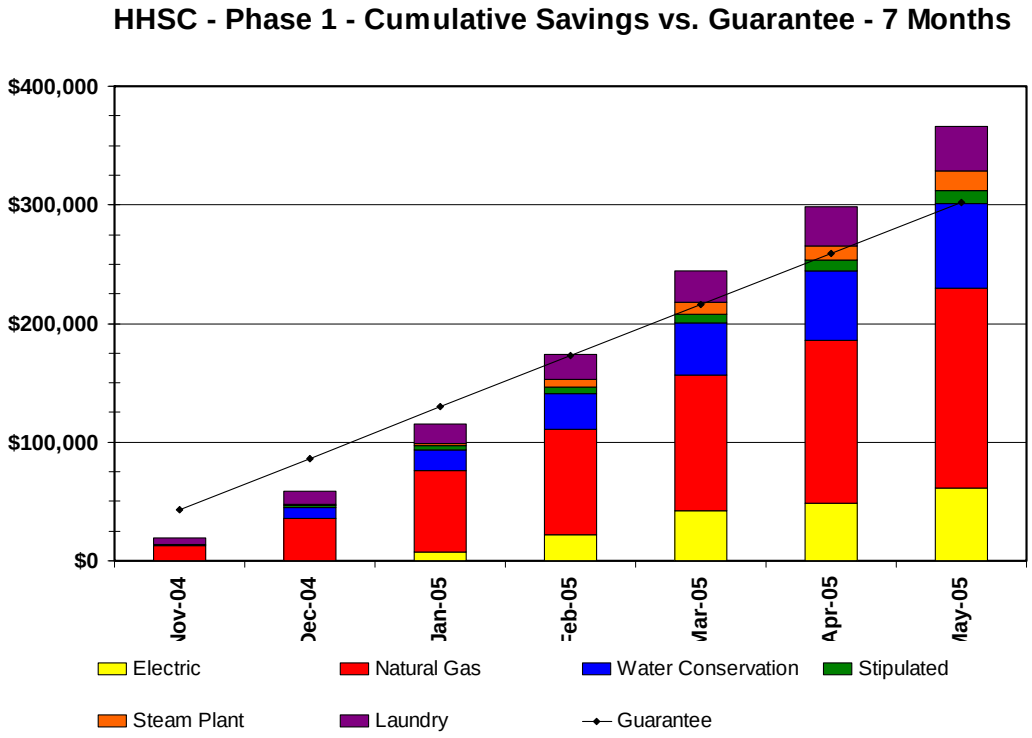

Figure 2. Seven Month Detailed Savings

First Quarter

Phase 1 Quarterly Summary
Beginning with January-05

Cost Savings					
	Baseline $	Measured $	Saved $	Guarantee	% Over
ASH	$291,730	$244,481	$64,384		
AUS	$170,911	$153,324	$35,456		
KSH	$141,919	$128,509	$16,778		
SASH	$227,027	$184,100	$54,252		
SASS	$69,402	$70,301	($899)		
Total	$900,989	$780,715	$169,972	$118,750	43%

Electricity Savings					
	Baseline kWh	Measured kWh	Saved kWh	Target kWh	% Difference
ASH	2,661,017	2,320,448	340,569	1,755,197	19%
AUS	1,514,736	1,350,000	164,736	1,352,536	12%
KSH	1,208,629	1,188,000	20,629	983,927	2%
SASH	1,580,990	1,386,000	194,990	717,708	27%
SASS	1,180,779	1,201,200	(20,421)	1,001,135	-2%
Total	8,146,151	7,445,648	700,503	5,810,502	59%

Demand Savings					
	Baseline kW	Measured kW	Saved kW	Target kW	% Difference
ASH	6,437	5,587	850	4,711	18%
AUS	3,704	3,156	548	3,093	18%
KSH	2,353	2,625	(272)	4,488	-6%
SASH	3,213	3,537	(324)	1,773	-18%
SASS	2,438	3,219	(781)	2,004	-39%
Total	18,145	18,124	21	16,069	-28%

Gas Savings					
	Baseline CCF	Measured CCF	Saved CCF	Target CCF	% Difference
ASH	247,113	198,441	48,672	92,337	53%
AUS	147,417	135,920	11,497	54,765	21%
KSH	93,180	77,660	15,520	60,309	26%
SASH	158,511	108,827	49,684	95,942	52%
SASS					
Total	646,221	520,848	125,373	303,354	151%

Table 1. Phase One - Site Quarterly Savings Summary

First Quarter

Phase I All Sites Quarterly Summary
Beginning with January-05

Cost Savings					
	Baseline $	Measured $	Saved $	Target Cost	% Difference
Jan-05	$316,260	$275,850	$51,424		
Feb-05	$294,236	$259,975	$53,528		
Mar-05	$290,493	$244,890	$65,020		
Total	$900,989	$780,715	$169,972	$118,750	43%

Electricity Savings					
	Baseline kWh	Measured kWh	Saved kWh	Target kWh	% Difference
Jan-05	2,607,638	2,474,553	133,085	1,888,452	44%
Feb-05	2,634,224	2,485,731	148,493	1,764,921	46%
Mar-05	2,904,289	2,485,364	418,925	2,157,129	81%
Total	8,146,151	7,445,648	700,503	5,810,502	59%

Electricity Demand Savings					
	Baseline kW	Measured kW	Saved kW	Target kW	% Difference
Jan-05	5,764	6,158	(394)	4,995	-93%
Feb-05	5,983	5,774	209	4,844	-8%
Mar-05	6,398	6,192	206	6,231	5%
Total	18,145	18,124	21	16,069	-28%

Natural Gas Savings					
	Baseline CCF	Measured CCF	Saved CCF	Target CCF	% Difference
Jan-05	248,870	194,299	54,571	123,134	169%
Feb-05	213,629	183,015	30,614	106,435	104%
Mar-05	183,722	143,534	40,188	73,785	234%
Total	646,221	520,848	125,373	303,354	151%

Table 2. Phase One - Monthly Savings Summary